

THE ALPINE VASCULAR FLORA OF THE MT. BROSS MASSIF, MOSQUITO RANGE,

COLORADO

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ABSTRACT: Mt. Bross is one of three mountains which form a massif in the northern part of the Mosquito Range in central Colorado. Each mountain in the massif is over 4267 m in elevation. The tundra flora of the Mt. Bross area was studied during the summers 1981-1984. A vascular flora of 167 species in 90 genera and 30 families is reported. Seven species are Colorado endemics. The phytogeographic distribution of the flora is primarily alpine and Western North American.

INTRODUCTION

The Mosquito Range is a north-south trending range which lies parallel to the Arkansas Valley on the west and South Park on the east in central Colorado. The range, with its often narrow and sharp crest, is a highly asymmetrical anticline which is steeply faulted on the west but gently sloping on the east (Chronic and Chronic 1972). The gentle easterly slope is composed of Paleozoic sedimentary rocks which rest upon a foundation of Precambrian metamorphics and granites (Patton, Hoskin and Butler 1912). Intersecting the Colorado Mineral Belt, the Mosquito Range is highly mineralized and has an extensive mining history continuing into the present. The range is deeply dissected by streams that originate near the steep western side and flow easterly, cutting through the overlying sedimentaries one to two thousand feet into the rocks of the Precambrian series.

Pleistocene glaciers which formed at the heads of the important streams in the range produced glacial cirques with perpendicular amphitheater walls and carved deep valleys with relatively steep sides as they moved downslope (Brown 1962). Extensive glacial moraines are found in the lower valleys.

Despite its relative accessibility (67 air miles from Denver) the Mosquito Range virtually is unexplored botanically (Baker 1983, Baker 1984). Prior to the work reported here, collections have been made in the Hoosier Pass and Monte Cristo creek areas to the north of the Mt. Bross massif by W.A. Weber of the University of Colorado Museum, Boulder. Collections were made in the Mt. Bross area during the summers 1981-1984. Nomenclature follows Kartesz and Kartesz (1980). Voucher specimens are deposited in CU-Denver. Phytogeographic abbreviations used in the annotated list of vascular

species are identified in the discussion section.

DESCRIPTION OF MT. BROSS

Mt. Bross is located in the northern part of the Mosquito Range. It forms a mountain massif along with three other mountains, Mt. Lincoln, Mt. Cameron and Mt. Democrat, each of which is over 4267 m in elevation. Located approximately 10 air miles northeast of Leadville, Mt. Bross and its south peak are in Sections 21, 22, 27, and 28, Township 8 South, Range 78 West of the Sixth Principal Meridian, Park County. Its elevation is 4319 m.

The summit of Mt. Bross is broadly rounded. The east and south slopes of the mountain are long and gentle. Steep slopes are found on the west and north flanks. The most conspicuous break in the generally rounded topography of the mountain occurs on the north in Cameron amphitheater, a glaciated cirque at the head of the major drainage in the area, Quartzville Creek. Steep cliffs form the headwall of this cirque. A smaller cirque, Bross amphitheater, is located on the east flank at the head of Moose Creek (Alma Quadrangle, Colorado, 7.5 minute USGS Topographic Map Series).

Quaternary deposits in the form of moraines, talus and solifluction deposits are the result of mass wasting, erosion and deposition during and following glaciation (Brown 1962). Only two of these, talus and solifluction deposits, occur in the tundra area studied. The talus is found primarily on the north and west sides of the mountain. The solifluction deposit occurs as a thin veneer across the east and south slope of the mountain.

Precambrian rocks in the Mt. Bross area are of two types, biotite schist and pegmatites. The biotite schist contains primarily quartz, biotite and plagioclase feldspar. The pegmatites are composed of microcline, quartz and muscovite (Brown 1962). Intrusive porphyries, mainly granodiorite and quartz monzonite, of the lower Tertiary and upper Cretaceous are found on the summit, along the south ridge and on the lower southeast flank of Mt. Bross (Patton, Hoskin and Butler 1912). Quartzites, shales and limestone of the Pennsylvanian circle the summit in a narrow belt. A broad belt of Paleozoic quartzite, calcareous sandstone and dolomite cover the remaining east and south slopes of the mountain (Brown 1962, Tweto 1974).

Several old mine roads traverse the east and south flanks. Prior to the discovery of the rich ore deposits around Leadville, Mt. Bross was one of the largest silver-producing mountains in the State of Colorado (Singewald 1947). Although a number of small mines and prospects were located in the area, the largest producers were the Moose and Dolly Varden mines, both located above 4030 m.

The climate of the Mt. Bross area is cold and wet. Heavy snowfall in the winter renders the area inaccessible from November through mid-June. Permanent snowbanks are found on and below the summit especially on the north-facing slope. The summer months are exceptionally wet as a result of almost daily thunderstorm activity.

VEGETATION OF MT. BROSS

Timberline occurs at approximately 3505 m on the south end and 3597 m on the north end of Mt. Bross. This means that the topographic relief of the mountain above timberline ranges from 814 - 722 m, south to north. As a result the tundra area is one of the most extensive in the Mosquito Range.

The predominant community types found on Mt. Bross are the dry and dry-moist meadows characteristic of the lower and middle tundra and the fellfield of the upper tundra including the summit. In many places the uniformity of the turf meadow is interrupted by tailings associated with old mining activity. Massive talus deposits which follow drainages downslope interdigitate to some extent with the turf meadow also.

A broad, belt-type, vertical zonation is apparent in the vegetation. Beginning at the summit and progressing downslope, fellfield communities are replaced by Carex - Kobresia-dominated meadows. These, in turn, are followed by a narrow belt of Potentilla fruticosa-dominated dry meadows. The lowest zone which occurs where the slope is most gentle and ends at timberline is characterized by a bunch grass, Agrostis - Danthonia - Calamagrostis dominance of dry and dry-moist meadows.

Slope exposure has a significant influence on community distribution. Northeast, east and southeast-facing slopes are covered with a well-developed turf meadow. The north and south-facing flanks are characterized by talus and fellfield communities whereas the southwest and west-facing slopes of the mountain are primarily unvegetated talus. The exposed summit is entirely fellfield. Frost-heave phenomena have created depressions which, because of greater soil accumulation, support the most diverse examples of this community.

Dry Meadow Community

Dry meadows occur in areas on convex slopes which experience snowmelt early in June. Numerous bare areas preclude the formation of a closed turf such as is found in the more mesic meadows. Caespitose monocots including Agropyron scribneri, Carex rupestris var. drummondiana, Danthonia intermedia, Kobresia myosuroides, and Poa rupicola are often the dominant species. Other dominants include bunch grasses such as Agrostis gigantea and Calamagrostis

purpurascens, Draba cana, Phacelia sericea, Polygonum bistortoides, P. viviparum, Potentilla fruticosa, and P. subjuga. Dry meadows dominated by the mat species, Dryas octopetala ssp. hookeriana, were restricted in occurrence to east-southeast-facing exposures. This community type has the greatest diversity of vascular plant species.

Dry-Moist Meadow Community

This community differs from the preceeding in several ways. Snow retention occurs later into the summer. As a result soil moisture is greater throughout the growing season. Soil development is better with a concomitant reduction in the amount of bare area with surfacing rock material; however, a good closed turf is absent. The most frequent dominants are Carex elynoides and C. rupestris var. drummondiana. Other species which predominate are Agropyron scribneri, Agrostis gigantea, Geum rossii var. turbinatum, Helictotrichon mortonianum, Polygonum bistortoides, and Trisetum spicatum. Some of the most frequently associated species include Artemisia campestris ssp. borealis, Campanula uniflora, Carex albonigra, Castilleja occidentalis, Cerastium earlei, Festuca brachyphylla, Luzula spicata, Phacelia sericea, Polemonium viscosum, and Saxifraga rhomboidea.

Moist Meadow Community

The only true moist meadows are found in swales on south-southeast and southeast-facing slopes where snow accumulation is undoubtedly favored by the concave surfaces. A good closed turf dominated by Geum rossii var. turbinatum and Polygonum bistortoides is present. Several taxa are highly specific for the moist meadow community: Chionophila jamesii, Epilobium anagallidifolium, Poa alpina, and Sibbaldia procumbens. Other species which achieve high densities within this community are Artemisia scopulorum, Carex heteroneura var. chalciolepis, Castilleja occidentalis, Mertensia bakeri, Oreoxis alpina, Polemonium viscosum, and Trifolium parryi.

Wet Meadow Community

A single wet meadow occurs in a seepy spring area upslope from a mine road near timberline. Carex nelsonii and Juncus drummondii are dominant. Only seven other species are found in this community: Caltha leptosepala, Polygonum bistortoides, Salix arctica, Saxifraga rhomboidea, Sedum integrifolium, Senecio triangularis, and Stellaria umbellata.

Fellfield Communities

Two kinds of fellfield communities are found on the Mt. Bross tundra. They differ in substrate composition and dominant vegetation. One of the communities consists of pebble-sized or smaller rock material and is dominated by cushion dicots including Paronychia pulvinata and Minuartia obtusiloba and the mat dicot, Trifolium nanum. A variation of this type of fellfield is characterized

by a substrate composed of larger rock material and is dominated by rosette dicots such as Smelowskia calycina and Draba nivalis. The cushion growth form is conspicuously absent. All of the latter type are found on the summit where environmental conditions are the most extreme and where frost-heave phenomena are apparent. In contrast to the species diversity of the two types of fellfields, the latter is decidedly less diverse in composition.

Dry Ledge Community

The dry ledge community is a composite of species which occur in cracks and crevices such as Festuca brachyphylla, Potentilla subjuga, and Smelowskia calycina and mat or cushion species which fan out over soil-filled depressions on or below rock overhangs: Oxytropis podocarpa, Paronychia pulvinata, Phlox caespitosa ssp. condensata, and Trifolium nanum.

Talus Community

Talus communities are characterized by a variety of dominants, a high diversity of total species present but a low density per given species. This probably reflects the opportunistic nature of many tundra species (Schaack 1983). Dominance is primarily attributed to the rosette and mat dicot growth forms with Claytonia megarrhiza, Geum rossii var. turbinatum, Oxytropis podocarpa, Polemonium viscosum, Senecio soldanella, and Trifolium nanum being the dominants. Any number of 62 species may be found in the various talus communities.

Shrub Tundra Community

Shrub tundra is highly restricted and localized in its occurrence in draws near timberline on Mt. Bross. Dominated by Salix glauca ssp. glauca var. villosa, the community is a mixture of tundra and subalpine species. In this regard it resembles the krummholz community found at timberline. Species restricted to shrub tundra are: Anaphalis margaritacea, Aquilegia coerulea, Castilleja miniata, Delphinium barbeyi, Deschampsia caespitosa, Moehringia lateriflora, Phleum alpina, Pseudocymopterus montanus, Ribes montigenum, and Valeriana capitata. Cirsium scopulorum is found only in this community and in disturbed areas around old mine sites. Most of the preceding species are subalpine in occurrence. Some of the common tundra species in the community are: Antennaria alpina, Artemisia scopulorum, Carex albonigra, Festuca brachyphylla, Mertensia bakeri, Polygonum bistortoides, P. viviparum, Silene acaulis var. subacaulis, and Trisetum spicatum.

ANNOTATED LIST OF SPECIES

SELAGINELLACEAE

Selaginella densa Rydb.

dry meadow, dry-moist meadow; A/WNA

PINACEAE

Abies lasiocarpa (Hook.) Nutt.

timberline, krummholz; BM/WNA

Picea engelmannii Parry ex Engelm.

timberline, krummholz; BM/WNA

Pinus aristata Engelm.

timberline, krummholz; BM/WNA

APIACEAE

Oreoxis alpina Coult. & Rose

dry meadow, dry-moist meadow, moist meadow, fellfield, talus;
A/SRM

Pseudocymopterus montanus (Gray) Coult. & Rose

dry meadow, shrub tundra; M/SRM

ASTERACEAE

Achillea millefolium L. var. lanulosa (Nutt.) Piper

dry meadow, dry-moist meadow, shrub tundra; A/WNA

Anaphalis margaritacea (L.) Benth. & Hook. ex C.B. Clarke

shrub tundra; BM/NAA

Antennaria alpina (L.) Gaertn.

dry meadow, dry-moist meadow, shrub tundra; AA/NAE

Antennaria anaphaloides Rydb.

dry meadow, dry-moist meadow, shrub tundra; BM/WNA

Antennaria microphylla Rydb.

dry-moist meadow; BM/NA

Artemisia campestris L. ssp. borealis (Pallas) Hall & Clements

dry meadow, dry-moist meadow, fellfield, rock crevice; AA/C

Artemisia frigida Willd.

fellfield; AA/NAA

Artemisia ludoviciana Nutt. ssp. incompta (Nutt.) Keck

dry meadow; M/WNA

Artemisia scopulorum (Greene) Cockerell

dry meadow, dry-moist meadow, moist meadow, talus, shrub tundra; A/RM

Chaenactis alpina (Gray) H.E. Jones

talus; M/WNA

Cirsium scopulorum (Greene) Cockerell

shrub tundra; A/RM

Crepis nana Richards.

talus; AA/NAA

Erigeron grandiflorus Hook.

shrub tundra; AA/NWA

Erigeron pinnatisectus (Gray) A. Nels.

dry meadow, dry-moist meadow, fellfield; A/SRM

Erigeron simplex Greene

dry meadow, dry-moist meadow, moist meadow, fellfield, shrub tundra; A/WNA

Haplopappus pygmaeus (Torr. & Gray) Gray

dry meadow, fellfield; A/RM

Heterotheca fulcrata (Greene) Shinnars

dry meadow, fellfield; M/RM

Hymenoxys acaulis (Pursh) Parker var. caespitosa (A. Nels.) Parker

dry meadow, fellfield; A/RM

Hymenoxys grandiflora (Torr. & Gray ex Gray) Parker

dry meadow, dry-moist meadow, fellfield, talus; A/RM

Senecio amplexans Gray var. holmii (Greene) Harrington

talus; A/WNA

Senecio canus Hook.

dry meadow, fellfield, talus; BM/WNA

Senecio soldanella Gray

fellfield, talus; A/CO

Senecio triangularis Hook.

wet meadow, shrub tundra; BM/WNA

Senecio werneriiifolius Gray

dry-moist meadow, fellfield, talus; M/RM

Taraxacum ceratophorum (Ledeb.) DC.

dry meadow, dry-moist meadow, shrub tundra; AA/C

BORAGINACEAE

Eritrichium aretioides (Cham.) DC.

dry meadow, fellfield, talus; AA/NAA

Mertensia bakeri Greene

dry meadow, dry-moist meadow, moist meadow, fellfield, talus; A/SRM

Mertensia ciliata (James ex Torr.) G. Don

shrub tundra; BM/WNA

BRASSICACEAE

Braya humilis (C.A. Mey.) B.L. Robins.

dry-moist meadow; AA/NA

Draba aurea Vahl

dry meadow, dry-moist meadow, fellfield; AA/C

Draba cana Rydb.

dry meadow, dry-moist meadow, fellfield; AA/C

Draba crassa Rydb.

talus; A/RM

Draba crassifolia Graham

dry-moist meadow; AA/NAE

Draba fladnizensis Wulfen

dry-moist meadow, fellfield; AA/C

Draba nivalis Lilj.

dry-moist meadow, fellfield, talus; AA/C

Draba oligosperma Hook.

dry meadow, fellfield, talus; AA/WNA

Draba streptobrachia Price

fellfield; A/CO

Draba streptocarpa Gray var. streptocarpa

fellfield; A/SRM

Erysimum capitatum (Dougl.) Greene var. amoenum (Greene) R.J. Davis

dry-moist meadow; A/SRM

Erysimum nivale (Greene) Rydb.

dry meadow, dry-moist meadow, fellfield, talus; A/SRM

Physaria alpina Rollins

dry meadow, fellfield, talus; A/CO

Smelowskia calycina (Steph.) C.A. Mey. ex Ledeb.

dry meadow, dry-moist meadow, fellfield, talus; AA/NAA

Thlaspi montanum L.

dry meadow, dry-moist meadow, moist meadow, fellfield, talus;
A/C

CAMPANULACEAE

Campanula rotundifolia L.

dry meadow; BM/C

Campanula uniflora L.

dry meadow, dry-moist meadow, fellfield, talus; AA/C

CARYOPHYLLACEAE

Arenaria fendleri Gray var. tweedyi (Rydb.) Maguire

dry meadow, dry-moist meadow, fellfield; A/SRM

Cerastium earlei Rydb.

dry meadow, dry-moist meadow, moist meadow, fellfield, talus,
shrub tundra; A/SRM

Minuartia obtusiloba (Rydb.) House

dry meadow, dry-moist meadow, moist meadow, fellfield; AA/NAA

Minuartia rossii (R. Br.) Graebn.

dry meadow, dry-moist meadow, fellfield, talus, shrub tundra;
A/NA

Minuartia rubella (Wahlenb.) Hiern

dry meadow, moist meadow, talus; AA/C

Moehringia lateriflora (L.) Fenzl

shrub tundra; AA/C

Paronychia pulvinata Gray

dry meadow, dry-moist meadow, fellfield, dry ledge; A/SRM

Silene acaulis (L.) Jacq. var. subacaulis (F.N. Williams) Fern. &
St. John

dry meadow, dry-moist meadow, moist meadow, fellfield, talus,
shrub tundra; AA/NAA

Silene drummondii Hook.

dry meadow, shrub tundra; BM/NA

Silene kingii (S. Wats.) Bocquet

dry-moist meadow; A/SRM

Silene uralensis (Rupr.) Bocquet ssp. uralensis

dry-moist meadow, fellfield, talus; AA/C

Stellaria umbellata Turcz. ex Kar. & Kir.

dry-moist meadow, moist meadow, fellfield, talus; A/NAA

CRASSULACEAE

Sedum integrifolium (Raf.) A. Nels. ex Coult. & A. Nels.

dry-moist meadow, moist meadow, talus, shrub tundra; AA/NAA

Sedum lanceolatum Torr.

dry meadow, dry-moist meadow, fellfield, talus, shrub tundra;
A/WNA

CYPERACEAE

Carex albonigra Mackenzie

dry meadow, dry-moist meadow, moist meadow, shrub tundra;
AA/WNA

Carex arapahoensis Clokey

dry-moist meadow; A/SRM

Carex ebenea Rydb.

dry-moist meadow; A/RM

Carex elynoides Holm

dry-moist meadow; A/WNA

Carex foena Willd.

dry-moist meadow; BM/NA

Carex haydeniana Olney

dry-moist meadow; A/WNA

Carex heteroneura W. Boott var. chalciolepis (Holm) F.J. Herm.

dry-moist meadow, moist meadow; A/WNA

Carex incurviformis Mackenzie

dry-moist meadow, moist meadow, talus; A/WNA

Carex nelsonii Mackenzie

wet meadow; A/SRM

Carex nova Bailey

dry-moist meadow; BM/WNA

Carex pyrenaica Wahlenb.

dry-moist meadow; A/C

Carex rupestris Bellardi ex All. var. drummondiana (Dewey) Bailey

dry meadow, dry-moist meadow, fellfield; A/RM

Kobresia myosuroides (Vill.) Fiori & Paol.

dry meadow, dry-moist meadow, fellfield; AA/C

Kobresia sibirica Turcz.

dry-moist meadow; AA/NAA

FABACEAE

Astragalus alpinus L.

fellfield, talus; AA/C

Oxytropis lambertii Pursh

dry meadow; M/NA

Oxytropis parryi Gray

dry meadow, dry-moist meadow; A/WNA

Oxytropis podocarpa Gray

dry meadow, dry-moist meadow, moist meadow, fellfield, dry ledge, talus; AA/C

Oxytropis sericea Nutt. ex Torr. & Gray

dry meadow, fellfield; BM/NA

Oxytropis viscida Nutt. ex Torr. & Gray

dry-moist meadow; A/WNA

Trifolium dasyphyllum Torr. & Gray

dry meadow, dry-moist meadow, fellfield, talus; A/RM

Trifolium nanum Torr.

dry-moist meadow, moist meadow, fellfield, talus; A/RM

Trifolium parryi Gray

wet meadow, talus, shrub tundra; A/RM

GENTIANACEAE

Frasera speciosa Dougl. ex Griseb.

dry meadow, fellfield; BM/WNA

Gentiana algida Pallas

dry-moist meadow, moist meadow; AA/NAA

Gentiana prostrata Haenke ex Jacq.

dry meadow, dry-moist meadow, shrub tundra; AA/NAA

Gentianella amarella (L.) Borner

dry meadow, dry-moist meadow, fellfield; BM/C

Gentianella tenella (Rottb.) Borner

dry meadow, dry-moist meadow; AA/C

Gentianopsis thermalis (Kuntze) Iltis

dry-moist meadow; A/RM

HYDROPHYLLACEAE

Phacelia sericea Hook.

dry-moist meadow, moist meadow, fellfield, talus; A/WNA

JUNCACEAE

Juncus drummondii E. Mey

wet meadow; A/WNA

Luzula spicata (L.) DC.

dry-moist meadow; A/RM

LILIACEAE

Calochortus gunnisonii S. Wats.

dry meadow; M/RM

Lloydia serotina (L.) Salisb. ex Reichenb.

dry meadow, dry-moist meadow, moist meadow, fellfield; AA/C

Zizadenus elegans Pursh

dry meadow, shrub tundra; AA/NA

ONAGRACEAE

Epilobium anagallidifolium Lam.
moist meadow; A/C

PAPAVERACEAE

Papaver lapponicum (Tolm.) Nordh. ssp. occidentale (Lundstr.)
Knaben
moist meadow, talus; AA/WNA

POACEAE

Agropyron scribneri Vasey
dry meadow, dry-moist meadow, fellfield, talus; A/WNA
Agropyron trachycaulum (Link) Malte ex H.F. Lewis var. latiglume
(Scribn. & Smith) Beetle
dry meadow, dry-moist meadow, shrub tundra; AA/NA
Agrostis gigantea Roth
dry meadow, fellfield; AA/C
Calamagrostis purpurascens R. Br.
dry-moist meadow, fellfield; AA/NAA
Danthonia intermedia Vasey
dry meadow, dry-moist meadow, fellfield; BM/NAA
Deschampsia caespitosa (L.) Beauv.
shrub tundra; BM/C
Festuca brachyphylla Schultes
dry meadow, dry-moist meadow, moist meadow, fellfield, dry
ledge, talus, shrub tundra; AA/C
Festuca ovina L.
dry meadow; AA/C
Helictotrichon mortonianum (Scribn.) Henry
dry meadow, dry-moist meadow, fellfield; A/SRM
Phleum alpinum L.
shrub tundra; AA/C
Poa alpina L.
moist meadow; AA/C
Poa arctica R. Br.
dry meadow, dry-moist meadow; A/RM
Poa epilis Scribn.
fellfield, talus; BM/WNA
Poa fendleriana (Steud.) Vasey
dry-moist meadow; BM/NA
Poa leptocoma Trin.
dry-moist meadow; A/WNA
Poa rupicola Nash ex Rydb.
dry meadow, dry-moist meadow, fellfield; A/WNA
Trisetum spicatum (L.) Richter
dry meadow, dry-moist meadow, moist meadow, fellfield, talus,
shrub tundra; AA/C

POLEMONIACEAE

Ipomopsis spicata (Nutt.) V. Grant ssp. capitata (Gray) V. Grant
dry meadow, fellfield, talus; M/WNA

Phlox caespitosa Nutt. ssp. condensata (Gray) Wherry
dry meadow, dry-moist meadow, fellfield, dry ledge; A/SRM

Polemonium viscosum Nutt.

dry meadow, dry-moist meadow, moist meadow, fellfield, talus;
A/WNA

POLYGONACEAE

Eriogonum jamesii Benth. var. xanthum (Small) Reveal
dry meadow, dry-moist meadow, fellfield; M/WNA

Polygonum bistortoides Pursh

dry meadow, dry-moist meadow, moist meadow, wet meadow, shrub
tundra; A/WNA

Polygonum viviparum L.

dry meadow, dry-moist meadow, shrub tundra; AA/C

PORTULACACEAE

Claytonia megarhiza (Gray) Parry ex S. Wats.
fellfield, talus; A/RM

Lewisia pygmaea (Gray) B.L. Robins.
moist meadow; A/WNA

PRIMULACEAE

Androsace septentrionalis L.

dry meadow, dry-moist meadow, moist meadow, fellfield, talus;
AA/C

Primula angustifolia Torr.

fellfield, talus; A/SRM

RANUNCULACEAE

Aquilegia coerulea James
shrub tundra; M/RM

Caltha leptosepala DC.
wet meadow; A/WNA

Delphinium barbeyi (Huth) Huth
shrub tundra; M/SRM

Ranunculus gelidus Kar. & Kir.
talus; AA/NAA

Ranunculus inamoenus Greene
dry-moist meadow; BM/WNA

ROSACEAE

Dryas octopetala L. ssp. hookeriana (Juz.) Hulten
dry meadow; A/RM

Geum rossii (R. Br.) Ser. var. turbinatum (Rydb.) C.L. Hitchc.
dry meadow, dry-moist meadow, moist meadow, fellfield, talus,
shrub tundra; AA/NAA

Potentilla diversifolia Lehm.

dry meadow, dry-moist meadow, moist meadow, fellfield, talus,

shrub tundra; A/WNA

Potentilla fruticosa L. ssp. floribunda (Pursh) Elkington

dry meadow, dry-moist meadow, fellfield, shrub tundra; BM/C

Potentilla gracilis Dougl. ex Hook. var. pulcherrima (Lehm.) Fern.

dry meadow, dry-moist meadow; BM/WNA

Potentilla hookeriana Lehm.

dry meadow, dry-moist meadow, fellfield; AA/NAA

Potentilla nivea L.

dry-moist meadow, fellfield; AA/C

Potentilla ovina Macoun

dry-moist meadow; M/WNA

Potentilla rubricaulis Lehm.

dry-moist meadow, fellfield, talus; AA/NA

Potentilla subjuga Rydb.

dry meadow, dry-moist meadow, fellfield, dry ledge, talus;

A/CO

Potentilla subjuga Rydb. var. minutifolia Rydb.

fellfield; A/CO

Sibbaldia procumbens L.

moist meadow, wet meadow; AA/C

SALICACEAE

Salix arctica Pallas

dry-moist meadow, wet meadow; A/WNA

Salix glauca L. var. villosa (Hook.) Anderss.

shrub tundra; BM/WNA

Salix reticulata Hook. ssp. nivalis (Hook.) Love, Love & Kapoor

dry-moist meadow; A/WNA

SAXIFRAGACEAE

Heuchera parvifolia Nutt. ex Torr. & Gray

dry meadow, dry-moist meadow; A/SRM

Ribes montigenum McClatchie

shrub tundra; BM/WNA

Saxifraga cernua L.

dry-moist meadow, fellfield, talus; AA/C

Saxifraga caespitosa L. ssp. monticola (Small) Porsild

fellfield, talus; A/C

Saxifraga chrysantha Gray

fellfield, talus; AA/NAA

Saxifraga flagellaris (Sternb.) Willd. ssp. platysepala (Trautv.)

Porsild

dry meadow, dry-moist meadow, moist meadow, fellfield, talus;

A/SRM

Saxifraga rhomboidea Greene

dry-moist meadow, moist meadow, wet meadow, fellfield, talus;

A/WNA

SCHROPHULARIACEAE

Besseya alpina (Gray) Rydb.

dry meadow, dry-moist meadow, fellfield, talus; A/SRM

Castilleja miniata Dougl. ex Hook.

shrub tundra; BM/WNA

Castilleja occidentalis Torr.

dry meadow, dry-moist meadow, moist meadow, fellfield, talus;
A/RM

Castilleja puberula Rydb.

dry meadow; A/CO

Chionophila jamesii Benth.

moist meadow, talus; A/SRM

Pedicularis parryi Gray

dry meadow, dry-moist meadow; A/RM

Pedicularis sudetica Willd. ssp. scopulorum (Gray) Hulten

shrub tundra; A/RM

Penstemon hallii Gray

dry-moist meadow; A/CO

Penstemon whippleanus Gray

dry-moist meadow; M/RM

VALERIANACEAE

Valeriana capitata Pallas ex Link

shrub tundra; AA/NAA

Valeriana edulis Nutt. ex Torr. & Gray

dry meadow, fellfield; BM/WNA

DISCUSSION

The alpine flora of the Mt. Bross massif consists of 167 species representing 86 genera in 28 families of angiosperms, three genera and three species of gymnosperms and one genus and one species of pteridophyte. A comparison of the seven leading families found in this study to those found in the San Juan Mountains, southwestern Colorado (Rottman 1984) and the Indian Peaks in the Front Range, northern Colorado (Komarkova 1979) is found in Table I.

The classification of phytogeographical units used includes both latitudinal (arctic, boreal) and altitudinal (alpine, montane) elements and con-elements. Latitudinal treeline separates arctic from boreal; altitudinal treeline separates alpine from montane. The names of the various subelements i.e., circumpolar, North American, Western North American, Rocky Mountains, Southern Rocky Mountains, Colorado, North American - Asiatic and North American - European are descriptive of geographical distribution patterns. Several of these subelements should be defined more specifically. The Rocky Mountains subelement includes the Northern Rocky Mountain province south to the Laramie Basin in Wyoming. The Southern

Table I. Comparison of Leading Families Found on Mt. Bross to San Juan Mountains and Front Range, Colorado.

Mt. Bross

Asteraceae
Poaceae
Brassicaceae
Cyperaceae
Caryophyllaceae
Rosaceae
Scrophulariaceae

Rottman (1984)
San Juan Mountains

Asteraceae
Cyperaceae
Brassicaceae
Saxifragaceae
Scrophulariaceae
Poaceae
Caryophyllaceae

Komarkova (1979)
Indian Peaks, Front Range

Asteraceae
Cyperaceae
Poaceae
Saxifragaceae
Caryophyllaceae
Brassicaceae
Scrophulariaceae

Rocky Mountains subelement includes southern Wyoming, Colorado, New Mexico, and Arizona. The Colorado subelement includes species which do not occur outside Colorado. Phytogeographic determinations for taxa are taken from Rydberg (1914), Porsild (1957), Weber (1965), Munz and Keck (1970), Komarkova (1979), Porsild and Cody (1980), and Moss (1983).

Table 2 shows the phytogeographic distribution of the flora reported. As may be seen from the percentages given the largest part of the vascular flora is made up of the alpine element (44.3%) and

Table 2. Phytogeographic Distribution of Vascular Plant Species,
Mt. Bross Tundra, Mosquito Range, Colorado.

Abbreviations cited in annotated list follow each unit.

Con-Element / Element	Abbreviation	Number of Taxa	Percent of Flora
BOREAL / MONTANE	BM	27	16.16
MONTANE	M	13	7.78
ARCTIC / ALPINE	AA	53	31.73
ALPINE	A	74	44.31
Subelement			
Circumpolar	C	34	20.35
North American	NA	11	6.58
Western North American	WNA	49	29.34
Rocky Mountains	RM	25	14.97
Southern Rocky Mountains	SRM	20	11.97
Colorado	CO	7	4.19
North American - Asiatic	NAA	19	11.37
North American - European	NAE	2	1.19

the Western North American subelement (29.3%). The circumpolar subelement (20.3%) which is largely identified with the arctic-alpine con-element is a second important component of the flora. With the exception of three species the North American-Asiatic subelement is linked also with the arctic-alpine con-element. In both the boreal-montane and montane con-elements the number of species in the Rocky Mountains subelement exceeds the number of Southern Rocky

Mountains species. The endemic species, Colorado subelement, are all alpine species and include: Castilleja puberula, Draba streptobrachia, Penstemon hallii, Physaria alpina, Potentilla subjuga, P. subjuga var. minutifolia, and Senecio soldanella.

A comparison of phytogeographic analyses between this study and that of Rottman (1984) in the San Juan Mountains shows a lower boreal-montane representation and a concomitantly higher montane representation. There is close agreement between the two studies in the arctic-alpine and alpine categories. In comparing the subelement categories, both the circumpolar and North American subelements are higher in the San Juans than on Mt. Bross; however, the Western North American subelement is 4% higher on Mt. Bross. The two studies yield very similar results in the Rocky Mountains, Southern Rocky Mountains and Colorado subelements.

In comparing the phytogeographic analysis of this study with that of the Indian Peaks area, northern Colorado (Komarkova 1979), an increase in the number of arctic-alpine (2%) and alpine (4%) species is noted. Among the subelement categories there is a decrease in circumpolar and North American-Asiatic species between Mt. Bross and the Indian Peaks area and a small increase in Western North American species. The number of North American-European species is virtually identical between the two studies.

The amount of diversity within an alpine flora is directly related to the diversity of habitats present (Hunter and Johnson 1983, Rottman 1984). The flora of the Mt. Bross massif is unusually diverse considering the lack of diversity found in habitat types and communities. Two families in particular, the Brassicaceae and Fabaceae, are important components of the flora in terms of species representation and cover values. Mt. Bross has 15 species of Brassicaceae compared to 12 for the San Juans (Rottman 1984) and nine for the Indian Peaks (Komarkova 1979). Nine species of Fabaceae occur on Mt. Bross compared to six for the San Juans (Rottman 1984) and three for the Indian Peaks (Komarkova 1979). This diversity in both families is even more amplified by the amount of cover exhibited by the family representatives. In the case of the Fabaceae high cover values are partly a result of the predominance of the mat dicot growth form among its members.

Infrequent and rare species may reflect local environmental conditions or distribution ranges, both altitudinal and phytogeographic. In the Mt. Bross tundra certain infrequent species such as: Anaphalis margaritacea, Calochortus gunnisonii, Delphinium barbeyi, Mertensia ciliata, Moehringia lateriflora, Valeriana capitata, and Zigadenus elegans are near the altitudinal limits of their distribution ranges. Other species are infrequent because their usual habitats are either absent or poorly-represented. These

species include: Aquilegia coerulea, Caltha leptosepala, Carex nova, Chaenactis alpina, Epilobium anagallidifolium, and Senecio amplexans. Several species, Gentianopsis thermalis, Penstemon whippleanus, Poa alpina, and Salix reticulata ssp. nivalis are surprisingly infrequent on Mt. Bross considering their frequent occurrence in other tundras of Colorado. Campanula rotundifolia is also in this category; however, it seems to be replaced by C. uniflora, a usually rare species elsewhere in the Colorado tundra. Papaver lapponicum ssp. occidentale, a rare and endangered species according to Weber (1976) is fairly common in the study area as are other rare species such as Gentianella tenella, Penstemon hallii, and Silene uralensis. The rare species according to Weber (1976) which are also rare in occurrence on Mt. Bross include Braya humilis, Draba streptobrachia, Erigeron grandiflorus, Pedicularis sudetica ssp. scopulorum, and Ranunculus gelidus.

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